The R & D and Standardization Activities of ARIB

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Abstract

Radio systems in the field of telecommunication and broadcasting, as seen in mobile phones, wireless LAN, ITS, digital broadcasting, have been increasingly sophisticated and diversified with the rapid advances in digital technologies. They are essential for our economic activities and social life. Research and development (R & D) and standardization for new radio systems have become more important, so that the role of the Association of Radio Industries and Businesses (ARIB), as a standards development organization (SDO) for radio systems, has been increasing. The paper describes the current overview and future challenges of ARIB.

1 ARIB

ARIB was established in response to several trends, such as the growing internationalization of telecommunications, the convergence of telecommunications and broadcasting, and the need for the promotion of radio-related industries. ARIB's goal is to rapidly advance the use of radio technology for the benefit of society. This is done by integrating knowledge and experience in the various fields of radio use, such as broadcasting and telecommunications, research & development (R & D) in radio technology, and by serving as a standards development organization (SDO) for radio technology.

ARIB was chartered by the Minister of Posts and Telecommunication as a public service corporation on May 15, 1995. Its activities include those previously performed by the Research and Development Center for Radio

System (RCR) and the Broadcasting Technology Association (BTA). ARIB renewed its organization based on the General Incorporated Association and General Incorporated Foundations Act in April 2011.

The main activities of ARIB are as follows:

(1) Study and R & D on the utilization of radio waves in the field of telecommunications and broadcasting,

(2) Consultation, enlightenment for dissemination, and collection and provision of material or information on the utilization of radio waves in the field of telecommunications and broadcasting,

(3) Development of standards relating to radio systems in the field of telecommunications and broadcasting, and

(4) Liaison, coordination and cooperation with foreign organizations relating to regarding the utilization of radio waves in the field of telecommunications and broadcasting.
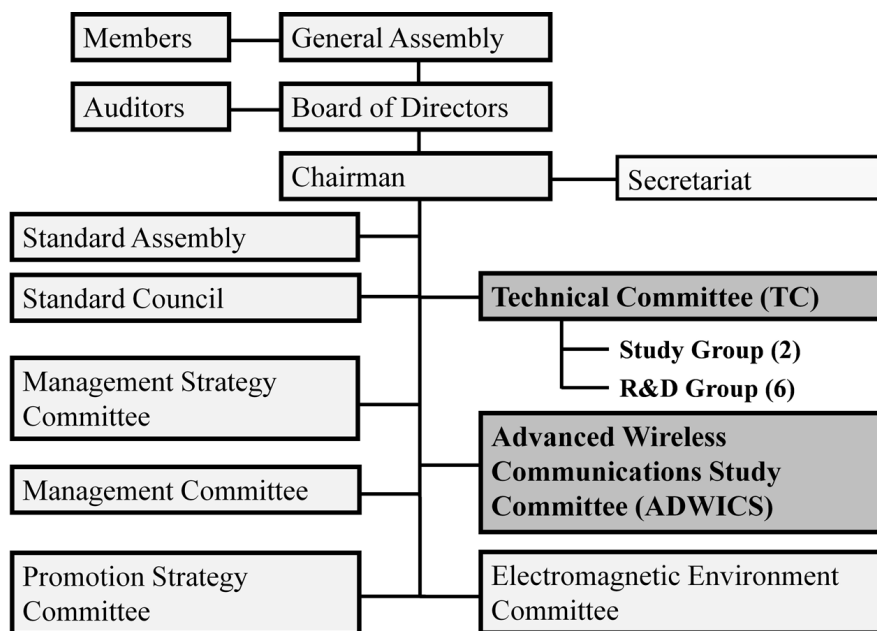
Figure 1 shows the organization of ARIB.

Figure 1   Organization of ARIB

2 Development of the ARIB STD and TR

ARIB, as an SDO, conducts study and R & D relating to the utilization of radio waves from the viewpoint of promoting practical application and dissemination of radio systems. Specifically, draft standards (STDs) and technical reports (TRs) are developed in two phases, i.e. "study" on the trends of demands and technologies, and "R & D" to specify new radio systems. The Technical Committee (TC) and the Advanced Wireless Communications Study Committee (ADWICS) play a fundamental role in this work. Two "study groups" and six "R & D groups" under the TC and five "subcommittees" under the ADWICS are organized in ARIB.

The outcomes from R & D groups and subcommittees are reported as draft to the TC and the ADWICS, respectively, and then various ARIB STDs and TRs are set in the Standard Assembly. Figure 2 shows the procedure for the development of ARIB STDs and TRs.

As of July 3, 2013, ARIB holds 152 STDs and 64 TRs as shown in Table 1. Among them, the major STDs include digital television broadcasting, digital sound broadcasting, terrestrial multimedia broadcasting, mobile communication systems, and Integrated Transport System (ITS).

The ARIB STDs and TRs can be downloaded free from the following URL:

http://www.arib.or.jp/english/html/overview/index.html.

3 Overview of the Technical Committee – Study Groups

3.1 Telecommunication Field

Currently, there is no active study group under the technical committee in the telecommunication field. Please see Chapter 6 for studies on advanced radio technologies including IMT.

Table 1   Number of STD and TR (As of 3July 2013)

Field	STD	TR
Telecommunications	92	23
Broadcasting	60	40
General	0	1
Total	152	64

ARIB

Ministry of Internal Affairs and Communications

<Study of Radio system>

The Information and Communications Council Information Technology Subcommittee <Technical Requirement>

The Radio Regulatory Council <Regulation, Frequency Utilization Plan>

Study groups for various themes

<R&D of Radio system>

Other organizations

R&D Groups for various themes

Draft ARIB Standard

Draft ARIB Standard

Reflection

Technical Requirement (Ministry Ordinance)

The Standard Assembly

The establishment of the ARIB Standard
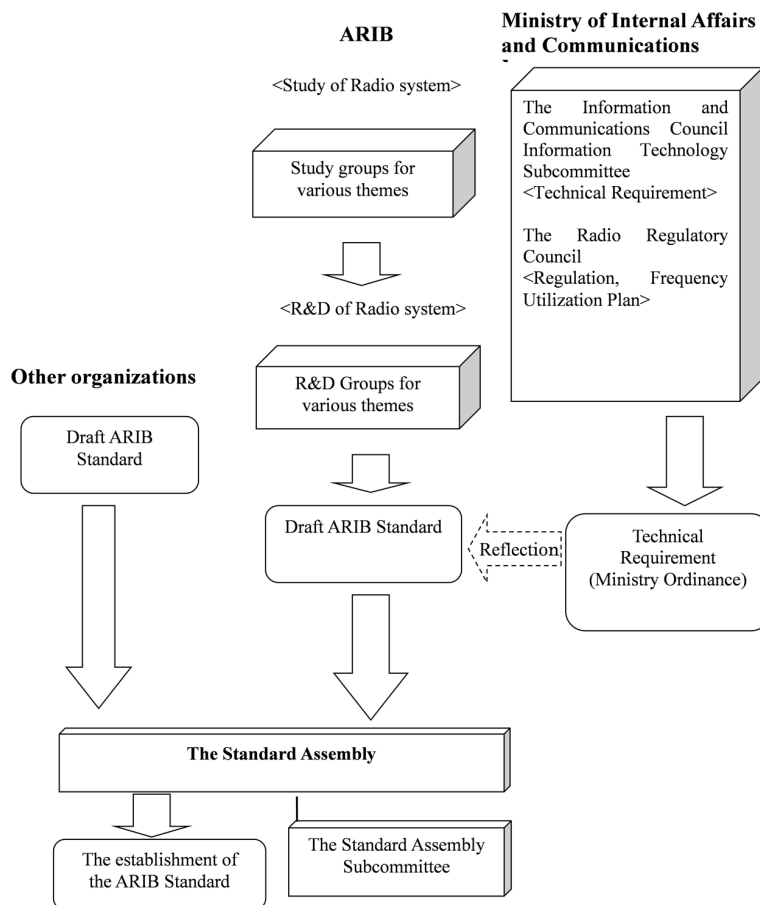
The Standard Assembly Subcommittee

Figure 2   Procedure for development of ARIB's STDs and TRs.

3.2 Broadcasting Field

3.2.1 Study group on the quality evaluation method for broadcasting

The purpose of this group is to study the evaluation method for the quality of video and sound in program content. The major activities are as follows:

- The study of the evaluation method for the quality of video and sound of program content in each production, transmission, and reception field, and
- The support of standardization for the quality evaluation method.

This group is working on the study of the quality evaluation method, the establishment of the guideline, and the production of the test sequence for a new broadcasting system and the related equipment.

It is progressing toward establishing a guideline for maintaining video quality during the real time transmission system of programs and news material over IP networks, as well as monitoring the quality of file-based program material and completed programs. The study extends a quality evaluation of the sound source in digital audio systems.

The group has improved the quality evaluation method for flat panel displays with regard to viewing conditions, such as monitoring characteristics and viewing distance. The results have been given to the International Telecommunications Union-Radio communications Sector (ITU-R).

The production of a new test chart for still images, which corresponds to high resolution (4k and 8k) as well as the wide color range, is also in progress.

3.2.2 Study group on new technology for a next generation broadcasting system

The purpose of this group is to study new broadcasting technology. The major activities include:

- The study of technology for a future 3D television,
- The study of a new service for hybrid broadcast broad band digital television (DTV), and
- The study of a transmission technology for next-generation digital broadcasting.

This group is surveying the trend for future glassless 3D technology, which is expected to be totally different from the present stereoscopic 3D system.

With respect to the new service, the group is studying the capability of Internet-connected TV in order to design a new service. It is also considering the key issues to realize this. Taking into account that the penetration of mobile phones and smart phones with a digital TV function would expand the environment with which to enjoy TV services, viewer expectations regarding such new services would need to be investigated.

For transmission technology, the group is considering a terrestrial broadcasting service with more than 100 M bit/sec transmission rate in the ultra-high frequency (UHF) TV band, along with the utilization of a sub-millimeter and millimeter over the 100 GHz band. The next step would be to design the system

image for digital broadcasting in the next generation, followed by identifying the issues to be studied.

4 Overview of the Technical Committee – R & D Groups

4.1 Telecommunication Field

4.1.1 R & D group on broadband wireless communication systems for public use

The 32.5MHz bandwidth (170 − 202.5MHz) within the newly available spectrum by the digitization of terrestrial TV broadcasting has been allocated for the broadband wireless communication systems for public safety.

Since this system consists of a portable base station (BS) and multiple mobile station (MS)s, it can be operated when and where it is needed. It is capable of providing several Mbps transmission data rate within the coverage area of several km from the BS.

One representative use case is high quality video image transmission from disaster areas to the local emergency headquarters. Standardization activity on technical specifications of the system for public use has been carried out in R & D group on broadband wireless communication systems and then ARIB STDT-103 has been developed.

4.1.2 R & D group on wireless lan systems

In response to rapid expansion of the use of wireless LAN systems, beginning with the off-load measures for smart phone traffic, R & D group on wireless LAN systems was established in April 2013 with a view to improve the reliability and advance the wireless LAN systems. The group will research and standardize wireless LAN systems with the cooperation and coordination with related standardization bodies.

4.2 Broadcasting Field

4.2.1 R & D group on digital broadcasting systems

The purpose of this group is to research and standardize the technical specifications, from transmission equipment to receivers in the digital broadcasting system. The major activities are as follows:

- R & D and standardization for the specifications with respect to multiplexing, the coding technique for video, sound, and data, data broadcasting,

copyright protection, and the management of access control, which are common to all systems.

- The R & D and standardization of the digital TV receiver for satellite and terrestrial, the digital sound broadcasting receiver for satellite and terrestrial, and the terrestrial mobile multimedia broadcasting receiver.
- The R & D and standardization of the transmission system for digital TV broadcasting for satellite and terrestrial, the digital sound broadcasting for satellite and terrestrial, and the terrestrial mobile multimedia broadcasting.

This group is a home for the standard of the digital television broadcasting (ISDB) family. ISDB-T for terrestrial TV and ISDB-Tmm for mobile multimedia broadcasting are among them.

STD and TR for the "area-limited ISDB-T" broadcasting system to be operated in the white spaces in the UHFTV band have been developed as ARIB STD-B55 and ARIB TR-B35.

An examination has been conducted to ease the sound level difference between stereo programs and down-converted 5.1-channel surround programs and then ARIB STD B-21 and the relevant ARIB TRs have been amended.

The group also devotes itself to devising specifications for 3D television systems. Some or all of the following points are considered when making various 3D television systems:

- Can 2D receivers display 3D programs?
- Is new video coding technology necessary?
- Can 3D program production be subject to 2D display, and
- Is the additional transmission band necessary?

Considering the necessary transmission bit rate and resolution for each system, as well as the available bit rate in conventional broadcasting systems, the most appropriate system will be selected. In addition to those mentioned earlier, the group makes efforts toward investigating technological trends in domestic and foreign organizations with respect to 3D television systems.

4.2.2 R & D group on program production systems

The purpose of this group is to research and standardize program production systems, editing systems, and transport system in and between broadcasting stations. The major activities are as follows:

- R & D and standardization for the transport system regarding the various auxiliary data,

- R & D and standardization for the interconnection specification between program production equipment,
- R & D and standardization for the measuring method for program production equipment,
- R & D and standardization for the data broadcasting program production system,
- R & D and standardization for the closed-caption program production system, and
- R & D and standardization for the operational technique of program production equipment.

New items being discussed include online exchange for the packaged program and the security of program files.

4.2.3 R & D group on the transmission of television program contribution

The purpose of this group is to research and standardize the transmission system for television program contribution at broadcasting stations. The major activities are as follows:

- R & D and standardization for the digital Field Pickup Unit (FPU) system, the transmitter-to-studio link (TSL) system, the sound contribution system, wireless microphones, and the high-capacity television program contribution in the millimeter frequency band,
- R & D and standardization for digital satellite newsgathering (SNG) systems, and
- R & D and standardization for the digital transmission system for domestic television networks.

In Japan, the frequency for the digital FPU system in the 700 MHz band is scheduled to move to the 1.2 GHz band and the 2.3 GHz band in order to expand the allocation for the mobile cellular system including LTE (Long Term Evolution), so called 3.9G in the 700 MHz band. The work is progressing, taking such domestic frequency re-allocation into account.

4.2.4 R & D group on ultra-high-definition television broadcasting systems

The purpose of this group is to research and standardize program production equipment that realizes a television broadcasting system with more than 1080 scanning lines. The major activities areas follows:

- R & D and standardization for video systems,
- R & D and standardization for sound systems, and
- R & D and standardization for the interface between equipment.

The group has been contributing to the ITU-R in order to devise the ultra-high-definition television (UHDTV) standards.

Considering, the progress in the ITU-R, the draft of the standard for a multichannel sound system that exceeds 5.1 surround channels is being prepared. The interface between the equipment will, based on video format specification, be standardized considering the trend in both the ITU-R and SMPTE.

In response to the establishment of the ITU-R Recommendation BT.2020, the group has researched and standardized the parameter values for UHDTV systems for production and international programme exchange, and then ARIB STD-B56 has been developed, choosing the parameters from the ITU-R Recommendation.

5 Overview of Advanced Wireless Communications Study Committee

Advanced Wireless Communications Study Committee was established in April 2006, through the reorganization of IMT-2000 Study Committee that focused on IMT. The objectives of the Committee is to conduct technical studies and contribute to international standardization in the areas of advanced radio technologies including IMT.

The scope of the Committee has been broadened several times, taking into account the development of mobile communications technologies. Currently, it covers IMT, Broadband Wireless Access (BWA) systems, Mobile commerce, Machine-to-machine communications and other wireless technologies. The Committee consists of five Subcommittees, i.e. Mobile Partnership Subcommittee, Standardization Subcommittee, BWA Subcommittee, Mobile Commerce Subcommittee and Multimedia Mobile Access Communications (MMAC) systems Subcommittee.

5.1 Mobile Partnership Subcommittee

The purpose of the group is to operate 3GPP, 3GPP2 and oneM2M as one of the Project Partner (Owner) and to facilitate ARIB member's activities in the Partnership Projects. The major activities are:

- Participate in 3GPPs/oneM2M as one of Organizational Partners of the Projects,
- Information exchange on 3GPPs/oneM2M activities and members' support in the Partnership Projects,
- Prepare contributions to 3GPPs/oneM2M on national regulatory aspects and transpose 3GPPs/oneM2M specifications to ARIB standards, and
- Information exchange on OMA (Open Mobile Alliance) activities.

Under the subcommittee, there are four 3GPPs support working group (WG)s, 3GPP Meeting Invitation Group (Japanese Friends of 3GPP), oneM2M support WG, and SIG (Special Interest Group)-OMA. The current main activities of 3GPPs support WGs are information exchange on relevant 3GPPs groups as well as reflection of national regulatory matters such as new radio band class into the specifications.

3GPP Meeting Invitation Group plans and coordinates to host 3GPP meetings in Japan. As for oneM2M support WG, the current main task of the group is the refinement of details of the oneM2M Partnership Project through the discussion with other Partners. SIG-OMA conducts information exchanges on OMA activities to facilitate the activities of the members.

5.2 Standardization Subcommittee

The purpose of this group is to conduct technical studies on future IMT (beyond what is studied in 3GPPs and IEEE) and to promote its international standardization through contributions to ITU and other activities. The major activities are the following:

- Study issues related to ITU-R WP5D and contribute to ITU-R WP5D,
- Cooperate and coordinate with related international/domestic bodies on IMT Standardization, and
- Prepare SDO contributions to ITU.

The main activity of this group is to study the ITU-R WP5D issues and contribute to national/international activities related with ITU-R WP5D. Collaboration Group (CG) under the Subcommittee conducts collaboration with external bodies, and its current main activity is collaboration with CCSA (China Communications Standards Association), TTA (Telecommunications Technology Association of Korea) on the issues of WP5D under the cooperation framework among 3 countries' SDO. At the each meeting among 3 SDOs, information and opinions has been exchanged, and the draft joint contributions for WP5D were often developed.

5.3 Broadband Wireless Access (BWA) Subcommittee

The purpose of this group is to conduct technical studies on BWA systems and standardization of their specifications as ARIB standards. The major activities are:

- BWA systems in the 2.5 GHz band of which technical requirements have been studied by Information and Communications Council,
- Information exchange on IEEE, WiMAX Forum and XGP Forum activities, and
- Transpose IEEE/WiMAX Forum/XGP Forum specifications to ARIB standards.

BWA subcommittee consists of four working group (WG)s. They mainly assume a role in producing national standards for Mobile WiMAX, IEEE802.20 and eXtended Global Platform (XGP) referring to relevant international standards.

International Relations WG establishes coordination framework with relevant international standardization bodies.

WiMAX WG develops and maintain ARIB standard for Mobile WiMAX system and to liaise with relevant international standardization bodies.

802.20 WG develops and maintains ARIB standard for IEEE802.20 TDD Wideband and 625k-MC Modes and to liaise with relevant international standardization bodies.

XGP WG develops and maintains ARIB standard for XGP system and to liaise with relevant international standardization bodies.

5.4 Mobile Commerce Subcommittee

The purpose of this group is to promote the development and standardization of Mobile commerce and to contribute to the growth of mobile contents market. The current major activities are the following:

- Study possible methods to incorporate official personal identification into mobile phone,
- Identify issues on the access to electronic government from mobile phone and study their solutions, and
- Study payment applications, using NFC built-in mobile phone.

5.5 MMAC Systems Subcommittee

The purpose of this group is to conduct technical studies on MMAC systems and standardize their specifications as ARIB standards. MMAC systems are portable Wireless Access System which can transmit ultra-high speed, high quality Multimedia Information using the SHF band $(3 - 30\text{GHz})$, the millimeter wave radio band $(30 - 300 \text{ GHz})$ and other band. The major activities are the following:

- Study on MMAC systems specifications,
- Information exchange and popularization activities related to MMAC systems, and
- Transpose IEEE specifications to ARIB standards.

MMAC systems subcommittee consists of three working group (WG)s. They mainly assume a role in producing national standards for IEEE802.11 and other original specification.

MMAC802.11 WG conducts study on the high throughput WLAN that are under development in IEEE 802.11, maintenance of ARIB STD-71, and drafting of its revision.

Ultra Wide Band (UWB) WG conducts experimental test of the propagation of UWB system considering real environments, exchange of information regarding the interference mitigation function among Asian country, maintenance of ARIB STD-91, and drafting of its revisions.

Wide Area Sensor Network (WASN) WG conducts study on WASN systems using many simple radio data terminals distributed over a wide area which perform data communications and information processing, study on specifications for WASN systems, and study on the mandatory requirements for government standards.

6 Collaboration with other SDOs

ARIB conducts activities on the liaison, coordination and cooperation with the International Telecommunication Union (ITU) and foreign standards development organizations related to radio systems in the field of telecommunications and broadcasting and the dissemination of the radio systems that was developed as ARIB Standards to foreign countries.

Table 2 shows the cooperation agreement, etc. that currently ARIB has entered into with the foreign standards development organizations, etc.

CCSA: China Communications Standards Association

Table 2 List of cooperation agreement, etc. with ARIB

Organization	Title	Date
TTA	Memorandum for mutual cooperation between ARIB and TTA	April 3, 1996
RAPA	Memorandum for mutual cooperation between ARIB and RAPA	April 3, 1996
3GPP	Third Generation Partnership Project Agreement	December 4, 1998
3GPP2	Third Generation Partnership Project Agreement for 3GPP2	January 27, 1999
CCSA, TTA, TTC	Memorandum of Understanding for mutual cooperation among CCSA, ARIB, TTC and TTA	November 7, 2002
KORA	Memorandum of Understanding between KORA and ARIB	December 12, 2005
SMPTE	Memorandum of Understanding between ARIB and SMPTE	February 14, 2007
ICU	Memorandum of Understanding between ARIB and ICU	June 23, 2009
GISFI	Letter of Intent between GISFI and ARIB	October 15, 2009
ITU, ARIB, CCSA, TTA, TTC	Memorandum of Understanding between ITU, ARIB, CCSA, TTA and TTC	July 6, 2011
ETSI	Co-operation Agreement between ETSI and ARIB	November 1, 2011

ETSI: European Telecommunications Standards Institute
GISFI: Global ICT Standardization Forum for India
ICU: Info communication Services Market Participants Union
ITU: International Telecommunication Union
KORA: Korea Radio Station Management Agency
RAPA: Korea Radio Promotion Association
SMPTE: Society of Motion Picture and Television Engineers
TTA: Telecommunications Technology Association
TTC: Telecommunication Technology Committee

7 Recent Achievement

Recent achievement of ARIB includes the development of the following new ARIB STDs and TRs.

7.1 Telecommunication Field

- 1.2GHz TV Whitespace-Band Land Mobile Radio Station for Specified Radio Microphone (ARIB STD-T112)
- 79GHz Band High-Resolution Rader (ARIB STD-T111)
- DSRC Basic Application Interface (ARIB STD-T110, TR-T22)
- 700MHz Band Intelligent Transport Systems (ARIB STD-T109, TR-T20)
- 920MHz-Band Telemeter, Tele control and Data Transmission Radio Equipment (ARIB STD-T108)
- 920MHz-Band RFID Equipment for Specified Low Power Radio Station (ARIB STD-T107)
- 920MHz-Band RFID Equipment for Premises Radio Station (ARIB STD-T106)
- Wireless MAN-Advanced System (ARIB STD-T105)
- LTE-Advanced System (ARIB STD-T104)
- 200MHz-Band Broadband Wireless Communication Systems between Portable BS and MSs (ARIB STD-T103)

7.2 Broadcasting Field

- UHDTV System Parameter for Program Production (ARIB STD-B56)
- Transmission System for the Area-limited Broadcasting (ARIB STD-B55, TR-B35)
- 4FSK Modulation Push-to-Talk Radio Communication Line for Broadcasting Operation (ARIB STD-B54)
- Receiver for Terrestrial Mobile Multimedia Broadcasting Based on Connected Segment Transmission (ARIB STD-B53, TR-B33 ISDB-Tmm)
- Operational Guidelines for Loudness of Digital Television Programs (ARIB TR-B32)

8 Conclusion

With the rapid advances in digital technologies, radio systems in the field of telecommunications and broadcasting has become a fundamental infrastructure that supports economic activities and social lives as well as creates a new culture.

To make further advancement of radio systems effectively, international cooperation to establish unified international standards for radio systems should be important.

With this point of view, ARIB will continue to conduct activities such as study and R & D on the effective utilization of radio waves in the field of telecommunications and broadcasting, development of standards, as well as liaison, coordination and cooperation with related foreign organizations, which, ARIB hopes, would contribute to enrich the ICT society.

Biography

Dr. Kohei Satoh joined the NTT Laboratories in 1975, and transferred to NTT DoCoMo in 1992. He has been a President and CEO of DoCoMo Communications Laboratories Europe GmbH in Munich, Germany, from November 2000 to May 2002.

In July 2002, he moved to Association of Radio Industries and Businesses (ARIB). He is now a Managing Director of ARIB, and his current job is to promote standardization activities on mobile communication systems for enhancement of IMT-2000 and for IMT-Advanced.

Since he joined ARIB, he has actively participated in ITU-R, 3GPP and other regional and domestic standardization activities for IMT. He is currently vice chairman of APT Wireless Forum and vice chairman of 3GPP Project Coordination Group.